PACIFIC SALMON COMMISSION
JOINT CHUM TECHNICAL COMMITTEE
2009 POST SEASON SUMMARY REPORT

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June 2011

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1. INTRODUCTION

This Pacific Salmon Commission (PSC) Joint Chum Technical Committee report presents the information on Chum salmon stocks and fisheries in southern British Columbia and Washington for the year 2009 to address the specific provisions and requirements of Chapter 6, Annex IV of the Pacific Salmon Treaty (PST) (Appendix 1). This was the first year of implementation for the version of Annex IV that was adopted January 2009.

The treaty between the governments of Canada and the United States of America (U.S.) concerning Pacific salmon was designed to facilitate co-operation between the two countries in the management, research and enhancement of Pacific salmon stocks. Chapter 6 of Annex IV (Chum Annex) of the PST required that certain fisheries for Chum salmon in southern British Columbia (B.C.) and Washington be managed in a specified manner. In each country other fisheries, while not specifically mentioned in the PST, are known to harvest Chum salmon originating in the other country. This report presents various aspects of the Chum salmon found in Washington State and in B.C. waters between Vancouver Island and the mainland and off the west coast of Vancouver Island, and discusses the management actions of Canada and the U.S. in relation to the PST requirements.

2. STATUS OF TREATY REQUIREMENTS

Chum salmon stocks and fisheries in southern British Columbia and in United States Areas 4B, 5, 6C, 7, and 7A (Appendix 2) were managed under the terms set out in Chapter 6, Annex IV (Appendix 1). The following provides a brief synopsis of the Canadian and U.S. management actions taken to meet its provisions in 2009.

2.1 Paragraph 1:

*The Parties were to maintain a Joint Chum Technical Committee ("*the Committee"*) reporting, unless otherwise agreed, to the Southern Panel and the Commission. [Specific tasks for the Committee are listed in Annex IV Chapter 6, Paragraph 1. Some of these include review stock status, develop new methods for stock management and report on management and research findings.]*

After the 2009 fishing season, the Committee convened three times in 2010: during the PSC post-season meeting in January, during the PSC annual meeting in February, and for additional work in LaConner, Washington, in May. The Committee published the 2007 and 2008 annual post season reports and continued development of criteria for endowment fund projects pertinent to genetic stock identification.

2.2 Paragraph 2:

When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods.

The Committee used historical estimates of stock contribution to assess Chum salmon stock composition for 2009 fisheries. These historical estimates may no longer be representative of current stock composition, and the Committee is currently evaluating new methods (Appendix 3).

2.3 Paragraph 3:

Canada and the United States shall assess catch levels and make attempts to collect additional genetic samples from any Chum salmon caught during the July 1 through September 15 time period in the boundary area fisheries (U.S. Areas 4B, 5, 6C, 7 and 7A; Canadian Areas 18, 19, 20, 21, and 29).

Tables 3 and 12 provide the harvest of Chum salmon during the period of summer Chum salmon migration in boundary areas. Due to the low numbers of Chum salmon encountered, neither party collected any samples for genetic stock identification (GSI) during this time period.

2.4 Paragraph 4:

During the period from July 1 through September 15, Canada will require the live release of Chum salmon from all purse seine gear fishing in the Strait of Juan de Fuca (Canadian Area 20) and the United States will require the same for the non-Indian seine fisheries in Areas 7 and 7A. Note: By U.S. regulation, purse seine fisheries are not permitted in U.S. Areas 4B, 5 and 6C.

Regulations were implemented by both countries to require the live release of Chum salmon in these areas during this time period.

2.5 Paragraph 5:

Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries to provide continued rebuilding of depressed naturally spawning Chum salmon stocks, and, to the extent practicable, not increase interceptions of U.S. origin Chum salmon. Terminal fisheries conducted on specific stocks with identified surpluses will be managed to minimize interception of non-targeted stocks.

Table 1 provides an evaluation of the performance of the Clockwork (2000–2001) and the current Johnstone Strait management strategy (2002–2009). Historical GSI results and genetic estimates from 2006 through 2008 indicated a continued low contribution of U.S. stocks in Johnstone Strait, Strait of Georgia and Fraser River Chum salmon fisheries.

The Committee presented a joint direction to the Southern Panel (Appendix 3), concerning the development of stock identification methodologies to be used for immediate and future application of stock assessment. This direction will help assess the contribution of depressed naturally spawning Chum salmon stocks to fisheries.

Fishery descriptions (see section 3.4) indicated that terminal areas fisheries were generally managed to minimize the interception of non-targeted stocks.

2.6 Paragraph 6:

Canada will manage its Johnstone Strait mixed stock fishery as follows:

a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical.

b) For run sizes above the critical threshold, Canada will conduct fisheries with an exploitation rate of up to 20% in Johnstone Strait of Inside Southern Chum salmon; and

c) When run sizes are expected to be below the critical threshold, Canada will notify the United States and will only conduct assessment fisheries and non-commercial fisheries. Commercial fisheries targeting Chum salmon will be suspended.

While no specific estimates of Inside Southern Chum salmon abundance were available, Canada indicated during the season, on the basis of inside area fisheries, that the run size was not at critical level (Table 1). Canada notified the U. S. of the abundance status.

2.7 Paragraph 7:

Canada will manage its Fraser River fisheries for Chum salmon as follows:

a) For Fraser River terminal area run sizes, identified in-season, at abundance levels lower than 900,000 Chum salmon, the Canadian commercial Chum salmon fisheries within the Fraser River and in associated marine areas (Area 29), will be suspended; and

b) For Fraser River terminal area run sizes, identified in-season at levels greater than 900,000 Chum salmon, Canadian commercial Chum salmon fisheries within the Fraser River, shall be guided by the limits of the in-river Total Allowable Catch set by Canada.

In 2009, in-season estimates indicated a terminal return higher than the specified Fraser River gross escapement threshold. Fisheries proceeded as per the Fraser River management rules (see section 3.3.3).

2.8 Paragraph 8:

Canada will manage the Nitinat gill net and purse seine fisheries for Chum salmon to minimize the harvest of non-targeted stocks.

In 2009, Canada addressed specific bycatch concerns by delayed opening dates (to early October), the use of reduced fishing areas, the use of weed lines, and species selective fishing techniques.

2.9 Paragraph 9:

Canada shall conduct a genetic sampling program of Chum salmon taken in the West Coast Vancouver Island troll fishery if early-season catch information indicates that catch totals for

the July 1 through September 15 season may reach levels similar to 1985 and 1986. Sampling, should it occur, will include catches taken from the southern areas (Canadian Areas 121–124).

Chum salmon catch levels in the 2009 West Coast Vancouver Island troll fishery were significantly below the 1985 and 1986 levels. Therefore, no GSI sampling occurred.

2.10 Paragraph 10:

The United States will manage its Chum salmon fishery in Areas 7 and 7A as follows:

a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical.

b) For run sizes below the critical threshold, the U.S. catch of Chum salmon in Areas 7 and 7A shall be limited to Chum salmon taken incidentally to other species and in other minor fisheries, but shall not exceed 20,000, provided that catches for the purpose of genetic stock identification sampling shall not be included in the aforementioned limit;

c) For run sizes above the critical threshold, the base catch ceiling for the U.S. Chum salmon fisheries in Areas 7 and 7A will be 130,000 Chum salmon;

d) Canada will provide a run size estimate of Chum salmon entering the Fraser River no later than October 22. If the estimate is less than 900,000, the U.S. will limit its fishery impacts on Fraser River Chum salmon by restricting catch in Areas 7 and 7A to not exceed 20,000 additional Chum from the day following the date the U.S is notified. The total catch is not to exceed the catch ceiling of 130,000 Chum salmon;

e) U.S. commercial fisheries for fall Chum salmon in Areas 7 and 7A will not occur prior to October 10;

f) *The U.S. will manage the Areas 7 and 7A fisheries for Chum salmon with the intent to minimize the harvest of non-targeted species;*

g) *No U.S. catch shortfalls may be accrued; however any overages shall be carried forward as indicated in (h) and (i);*

h) *Due to management imprecision, a catch in the U.S. of up to 135,000 Chum salmon will not result in an overage calculation. Catches in excess of 135,000 Chum salmon shall result in an overage being calculated by subtracting 130,000 from the total Chum catch. Overages will be accounted for by reducing the U.S. annual catch ceiling in up to two subsequent non-critical Inside Southern Chum salmon years; and*

i) *From the day following the date the U.S. is notified of a run size below the critical threshold as defined in 10(b) or (d), any catches in excess of 20,000 Chum salmon*

will result in an overage. Overages will be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern Chum salmon years.

In 2009, U.S. fisheries in Areas 7 and 7A were conducted in accordance with the above provisions (see section 4.3). In 2009, the U.S. commercial fisheries in Area 7 and 7A commenced on October 10 through November 15 (see section 4.3.2). These fisheries were managed to minimize the capture of non-targeted species. These fisheries did not need further modification based on the status of the Fraser River abundance.

2.11Paragraph 11:

The United States shall conduct its Chum salmon fishery in the Strait of Juan de Fuca (United States Areas 4B, 5, and 6C) so as to maintain the limited effort nature of this fishery, and, to the extent practicable, not increase interceptions of Canadian origin Chum salmon. The United States shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

This fishery is restricted to Treaty Indian fishers from four tribes and to gill net gear only. The technical committee has not specifically addressed interception estimates during the 1994 through 2009 time period. Genetic stock identification (GSI) samples collected from this fishery in prior years indicate the majority of the catch is Chum salmon of U.S. origin. The total catch and effort in this fishery has remained at historically low levels (see Table 11).

2.12 Paragraph 12:

All information concerning bycatch of other salmon species from the Chum salmon fisheries covered by this chapter will be shared between the Parties in the annual Post Season Report.

Bycatch species were reported in the annual post season reports of the Parties.

2.13 Paragraph 13:

Should circumstances arise that are inconsistent with either Parties understanding of the intent of the chapter, the Southern Panel will discuss the matter postseason and explore options for taking the appropriate corrective actions.

No such circumstances arose in 2009.

3. SOUTHERN BRITISH COLUMBIA CHUM SALMON

3.1 Introduction

Southern B.C. Chum salmon stocks and fishing Pacific Fishery Management Areas (PFMAs or Areas; Appendix 2) are, for the purposes of management, analysis and reporting, grouped into four major units: Johnstone Strait, Strait of Georgia, Fraser River, West Coast Vancouver Island (WCVI). Additionally, Chum salmon originating from Johnstone Strait, the Strait of Georgia, and the Fraser River are collectively described as Inside Southern Chum salmon.

3.2 Status of Treaty Requirements

During 2009, the Southern B.C. Chum salmon fisheries were managed according to the requirements of Annex IV, Chapter 6, as amended in 2009 (Appendix 1).

3.3 Conservation and Harvest Management Requirements

The general management approach adopted by Fisheries and Oceans Canada (CDFO) for Southern B.C. Chum salmon is to achieve wild escapement targets, while augmenting production through enhancement of selected stocks. In practice, this approach is achieved through the application, in mixed stock fisheries, of harvest rates which are compatible with wild or natural stock productivity. If there are Chum stocks which return to their area of origin in numbers above that area's escapement goal, they may be subject to additional harvesting within their terminal areas.

The following describes the management strategies and fishing plans for the four units of Southern B.C. Chum salmon stocks in relation to these above requirements.

3.3.1 Johnstone Strait Chum Salmon Management Strategy

The Clockwork management strategy, in use from 1983 to 2001 in the Johnstone Strait Chum salmon fisheries (Area 12 & 13), was a stepped exploitation rate approach and is described in the 1985 Post-Season Summary Report of the PSC Joint Chum Technical Committee (TCCHUM 87-4). The Clockwork strategy was designed to rebuild wild Inside Southern Chum salmon stocks to the estimated optimum escapement levels by limiting the overall harvest rate. Ryall *et al.* 1999 (Canadian Stock Assessment Secretariat Research Document 99/169), provided an assessment of the effectiveness of the Clockwork strategy. The Clockwork strategy required accurate estimates of catch and escapement and the reliability of this strategy depended upon the quality of these data. During the time period in which Inside Southern Chum salmon stocks were managed by the Clockwork strategy, the high variability in Chum salmon returns, the inadequate escapement coverage, and highly unstable fishing opportunities demonstrated a need to move to an alternative approach.

Following extensive technical reviews and several years of discussions with First Nations, stakeholders and the commercial fishing industry, the Clockwork's stepped exploitation rate approach was replaced in 2002 by a stable fishing schedule designed to approximate a fixed exploitation rate (~20%). Tagging studies conducted from 2000 through 2002 helped in the development of this fixed exploitation rate strategy by assessing the migration timing and harvest rate by fishing gear on an available abundance of Chum salmon in Johnstone Strait. This fixed exploitation strategy continued to be employed through 2009.

Some of the key objectives of this strategy are to ensure sufficient escapement levels while providing more stable fishing opportunities. The exploitation rate is set at 20% across all harvesters, when abundance is estimated to be above a critical level. The critical level, or threshold, was determined to be 1.0 million Chum salmon (Appendix 1). The Johnstone Strait Chum test fishery, as well as the information gained from any commercial openings, is used in-season to determine the likelihood of achieving the critical level for Inside Southern Chum salmon. When expected levels are less than 1.0 million, only assessment fisheries and non-commercial fisheries will be conducted and any planned commercial fisheries targeting Chum salmon will be suspended (Appendix 1). When the critical level is expected to be achieved, fisheries with an exploitation rate of up to 20% in Johnstone Strait can be conducted (Appendix 1).

Of this 20%, the commercial sector is allocated 15%. The remaining 5% is set aside to provide for First Nation's Food, Social and Ceremonial needs (FN FSC), satisfy recreational and test fishing requirements, and to provide a buffer to the commercial exploitation. The impact of the Johnstone Strait fisheries, Clockwork years (1998–2001) and the subsequent fixed exploitation approach (2002–2009), on Inside Southern Chum salmon stocks are detailed in Table 1.

The specific objectives of the fixed exploitation rate strategy are to:

a. continue to rebuild/maintain stocks to the optimum wild escapement objective (defined as 2.5 million wild Inside Southern Chum salmon);
b. establish a pre-season fishing plan to achieve an exploitation rate of 20% on Inside Southern Chum salmon in the Johnstone Strait Chum fishery; and,
c. stabilize commercial catch rates to provide opportunities at both low and high abundance levels.

3.3.2 Strait of Georgia Chum Salmon Management Strategy

Chum salmon stocks returning to terminal areas within the Strait of Georgia (Areas 14-19) are directly affected by the harvest in Johnstone Strait. Chum salmon returning to mid-Vancouver Island (Area 14) are primarily from enhancement facilities. Terminal harvesting is directed at a mix of surplus mid-Vancouver Island wild and enhanced Chum salmon. Conservation requirements of local Chinook and Coho salmon and passing Chum salmon stocks are also considered in the determination of area and time closures for Area 14 Chum salmon fisheries.

Other areas in the Strait of Georgia where terminal surpluses may be available are Jervis Inlet (Area 16), Nanaimo (Area 17), Cowichan (Area 18) and Saanich Inlet (Area 19). Terminal surpluses in these areas are estimated from in-season escapement, test fishing and commercial harvesting data when available.

Table 1. Assessment of the Clockwork (stepped harvest rate) and the current (fixed harvest rate) Johnstone Strait Chum Salmon Management Strategy, 2000–2009.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
PRE-SEASON										
Inside Southern Abundance Forecast	Below Average	Below Average	Average to Above Average	Below Average	Average	Average to Above Average	Average to Above Average	Average to Above Average	Below Average	Below Average
IN-SEASON										
Management Strategy	Clockwork	Clockwork	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
POST-SEASON										
Inside Southern Abundance [1]	1,235,716	4,869,355	5,090,213	3,528,029	5,482,287	3,073,916	4,289,905	2,630,266	2,226,348	2,180,727
Inside Southern Harvest	263,393	754,980	1,600,789	1,298,112	1,838,443	1,251,536	1,515,578	788,025	577,518	741,481
Est. Inside Southern Harvest Rate	21.3%	15.5%	31.5%	36.8%	33.5%	40.7%	35.3%	30.0%	25.9%	34.0%
Johnstone Strait Harvest										
Commercial, Sport Areas 11-13 [2]	176,980	209,914	668,936	924,505	1,176,611	856,029	859,201	480,620	299,775	517,974
First Nations Areas 11-13	13,621	23,562	17,131	14,780	27,041	18,841	16,453	14,870	11,630	13,151
Johnstone Strait Harvest Total	190,601	233,476	686,067	939,285	1,203,652	874,870	875,654	495,490	311,405	531,125
Target Johnstone Strait Harvest Rate	*10%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
Est. Johnstone Strait Harvest Rate	15.4%	4.8%	13.5%	26.6%	21.9%	28.5%	20.4%	18.8%	14.0%	24.4%
ESCAPEMENT (includes wild and enhanced) [3]										
Inside Southern Escapement	972,323	4,114,375	3,489,424	2,229,917	3,643,844	1,822,380	2,774,327	1,842,241	1,648,830	1,439,246

(1) Total Inside Southern stock includes total Inside Southern harvest plus escapement. Harvest composition based on historic GSI for all fisheries.
(2) Includes commercial, sport and test fishery catches.
(3) Escapement numbers do not include any removals associated with hatchery rack. Those values are included in harvest.

3.3.3 Fraser River Chum Salmon Management Strategy

The management strategy for Fraser River Chum salmon includes management goals and harvest allocation objectives for Chum salmon fisheries occurring within the Fraser River. Fisheries are structured to ensure a spawning escapement of 800,000 using in-season information on returning Chum salmon abundance. Decision rules that guide the management of Fraser River Chum salmon fisheries are summarized in Table 2.

Management of Chum salmon fisheries occurring within the Fraser River is guided by the need to minimize impacts on co-migrating stocks of concern, including Interior Fraser Coho salmon and Interior Fraser Steelhead. In order to limit incidental impacts on Interior Fraser Coho salmon, fishing for all sectors (First Nations, recreational, and commercial) is restricted from early September to mid-October within the Fraser River mainstem below Sawmill Creek. Conservation measures taken to protect Interior Fraser Steelhead are developed in conjunction with the B.C. Ministry of Environment on an annual basis, and are primarily focused on reducing the impact of Fraser River commercial gillnet fisheries. In recent years, these restrictions have resulted in the delay of commercial fishing opportunities for Chum salmon until late October, with the exception of those fisheries that operate with selective gear. Fisheries that occurred in 2009 are summarized in section 3.4.3.

Table 2. Key decision points for Fraser River Chum salmon management.

Run Size	Harvest Plan	First Nations	Commercial	Recreational
<800,000 in Fraser	<10%	Limited (Reduced hours and days / week fishing)	Closed	Restricted openings
800,000–916,000 in Fraser	Harvest not to exceed 81,000 (72,000 First Nations and 9,000 test fishing)	Normal (72,000)	Closed	Tributary openings
916,000–1,050,000 in Fraser	Commercial harvest not to exceed 10% for Chum salmon.	Normal (72,000)	Open (35,000–105,000)	Open
>1,050,000 in Fraser	Commercial harvest not to exceed 15% for Chum salmon.	Normal (72,000)	Open	Open

3.3.3.1 Fraser River In-season Run Size Estimation

The Albion test fishery has operated every year on the Fraser River in Area 29 since 1979, providing the catch data used to estimate the abundance of Chum salmon returning to the Fraser River. Chum salmon returns are estimated using a Bayesian model that incorporates pre-season information on run size and migration timing, with in-season information on Chum salmon catch from the Albion test fishery, to estimate the abundance of returning Fraser River Chum salmon

(Gazey and Palermo 2000). The Albion Chum salmon test fishery normally operates from September 1 through November 30.

The first in-season estimate of Fraser River Chum salmon returns is typically provided on or about October 15. Limited food, social, and ceremonial (FSC) fisheries for Fraser Chum salmon may be permitted prior to this date, unless a conservation concern has been identified.

In 2009, Chum salmon test fishing began on September 1 and was conducted every alternate day until October 21 when Chinook test fishing was terminated and Chum test fishing then continued on a daily basis. Fraser Chum salmon catches in the Chum test net (6.75" mesh) from September 1 to November 23, representing 56 test fishing days, totalled 7,003 Chum.

3.3.4 West Coast Vancouver Island Chum Salmon Management Strategy

Chum salmon stocks return to all areas on the West Coast of Vancouver Island (WCVI). When stock abundance allows, commercial Chum salmon fisheries are conducted in the marine waters outside Nitinat Lake (Area 21), Barkley Sound (Area 23), Clayoquot Sound (Area 24) and Outer Nootka Sound/Tlupana and Esperanza Inlet (Areas 25). Both commercial gill net and purse seine fleets target WCVI Chum salmon in these Areas.

A pre-season forecast of the return of WCVI Chum is predicted for population aggregates corresponding to CDFO's PFMAs. Natural and enhanced returns are approximated through separate models and summed to produce a total return forecast for each Area. However, the relative inaccuracy of the pre-season forecasts resulted in the adoption of a fixed harvest rate strategy in the early 2000's for those fisheries targeting wild or mixed stock aggregates.

With the exception of near-terminal areas, such as Nitinat (Area 21 & 22) or Tlupana Inlet (Area 25) where hatchery stocks dominate, WCVI Chum salmon fisheries are currently managed to an exploitation rate of approximately 20% or less. Exploitation is controlled by limiting fishing effort to specific areas, specific times or to a specific number of vessel fishing days per week. Purse seine opportunities generally occur when excess salmon to spawning requirements (ESSR) are identified near terminal areas (e.g. hatchery stocks returning to Nitinat River or Tlupana Inlet).

Since the late 1990's, most of the commercial harvest has occurred offshore of Nitinat Lake (Area 21) or in Nootka Sound/Tlupana Inlet (Area 25). However, starting in 2004, the commercial gill net sector conducted limited small fleet fishing opportunities for Chum salmon in terminal areas other than Nitinat and Nootka/Tlupana. The intent was to determine if small scale gill net fisheries could be economically viable while limiting exploitation rates to 10 to 20% of returning stocks. Additionally, it was expected these limited fleet fisheries could provide useful stock assessment information. Areas of interested included: Barkley Sound (Area 23), Clayoquot Sound (Area 24), and Esperanza Inlet (Area 25).

WCVI First Nations FSC fisheries remain a priority and occur in terminal areas targeting individual populations from river systems within or adjacent to band territories. Catch limits may be set when there are conservation concerns for the target population; however, First

Nations FSC fisheries have priority over other fisheries. Generally, catch and effort in FSC Chum fisheries is low compared to commercial Chum fisheries.

Chum salmon are not commonly targeted by recreational anglers on the WCVI . Nevertheless, the WCVI recreational Chum salmon catch is estimated annually through a Creel Survey conducted by CDFO. Creel Survey information is augmented by logbook and manifest records of catch and effort submitted by lodges operating guided fishing trips on the WCVI. These data are compiled and analyzed to produce catch and effort statistics by Area for each salmon species.

3.3.4.1 Nitinat Chum Salmon Management Strategy

Of importance to the Pacific Salmon Treaty is the WCVI group of Chum salmon populations returning to the Nitinat watershed (Nitinat River and Nitinat Lake & tributaries). This Nitinat stock is the most significant WCVI group of populations and includes production from a major CDFO hatchery on the Nitinat River.

The Nitinat commercial Chum salmon fishery (Area 21), along with the test fishery and ESSR fisheries (Area 22), is the largest fishery on the WCVI and targets returning Nitinat River hatchery Chum salmon. In the past, catch of non-WCVI Chum salmon has occurred in the outside seaward portion of the Nitinat fishing area. Management actions have been implemented to reduce this catch of non-WCVI Chum salmon by restricting the Nitinat fishery to subareas closer to the terminal area (i.e. outlet of Nitinat Lake). More recently, First Nations' ESSR harvests have occurred within Nitinat Lake (Area 22). Historical Chum salmon catches are shown in Table 5.

A *net escapement requirement* (i.e. spawning escapement) for Chum salmon returning to the Nitinat system has been set at 175,000 fish; this includes 150,000 into the Nitinat River and 25,000 into other Nitinat Lake tributaries. This spawning escapement requirement is set at a level to ensure that all run timing components are represented. Additional allocation for test fishing harvest in Nitinat Lake and hatchery requirements (i.e. broodstock) may total up to 75,000 Chum salmon. Consequently, the *gross escapement requirement* (spawning escapement + test fishery harvest + hatchery requirements) for this Nitinat group of populations is 250,000 Chum salmon. Historical total Chum salmon escapements are shown in Table 5.

A pre-season forecast of current year returns for the Nitinat stock is approximated based on broodyear escapements, estimated freshwater production from natural spawners, hatchery production, average age at return, environmental and ocean condition factors during brood ocean entry and estimated marine survival of each brood year class.

The pre-season fishing plan is based on the forecast and may provide for early opportunities for gill net and limited effort purse seine fishing. Depending on in-season test fishing results, achieving escapement milestones into Nitinat Lake, and on the catch allocation between the two net fisheries, these early opportunities may be followed later in the season by the traditional full fleet purse seine and gill net fisheries.

In addition to concerns over catch of non-WCVI Chum salmon, early season opportunities are constrained by concerns over bycatch of Interior Fraser River Steelhead (Thompson River) and

passing stocks of Coho salmon. Since 1995, these bycatch concerns in the commercial Nitinat fishery have been addressed by:

- delayed opening dates: the first commercial gill net fishery, if conducted, has been delayed until the beginning of October since 1998;
- reduced fishing areas: the traditional fishing area has been reduced to within a one-mile boundary between lines true south from Pachena and Dare Points (a portion of Area 21);
- increased use of weed lines: a 1.2m - 2.0m weed line for gill nets; and,
- species selective fishing techniques: non-retention of Coho salmon and steelhead.

Additionally, to reduce bycatch mortality and to improve the quality of catch data, the following measures have been implemented in the Nitinat fisheries:

- daylight fishing only: gill net fishery;
- mandatory functional revival tanks: in purse seine and gill net fisheries;
- onboard observers: portions of purse seine and gill net fleet; and,
- logbooks and weekly hail-ins: purse seine and gill net fisheries.

The in-season management of the Nitinat fisheries (Area 21 & 22) are based on achieving the *gross escapement requirement* into the Nitinat watershed. A gill net test fishing vessel (recently operating in Nitinat Lake), broodstock collection success, hatchery swim-ins, and visual surveys of Nitinat River spawners are used to determine whether the weekly *escapement milestone levels* into Nitinat Lake are achieved. Weekly fisheries are generally scheduled in Area 21 and surrounding waters to harvest any identified surplus.

First Nations FSC fisheries remain a priority and occur in terminal areas of Nitinat (Areas 21 & 22). First Nations ESSR fisheries can also occur in Nitinat Lake (Area 22) targeting returns surplus to spawning and hatchery requirements.

3.4 Annual Fishery Descriptions

Fisheries targeting Chum salmon in Johnstone Strait, the Strait of Georgia, the Fraser River and on the West Coast of Vancouver Island (WCVI) generally begin in late September and end in November. These fisheries are directed at fall Chum salmon.

In addition to these directed fisheries, a bycatch of Chum salmon may occur in fisheries directed at Sockeye and Pink salmon earlier in the season. This Chum salmon by-catch is assumed to be comprised mainly of summer Chum salmon. The summer Chum salmon catches in boundary area fisheries are presented in Table 3.

Pre-season expectations for Southern B.C. fall Chum salmon stocks in 2009 was for a below average return. This was based on an anticipation of poor survivals of the dominant 4 year old age class from the 2006 outmigration year, (evident in both weak Pink and Coho salmon returns in 2007) and lower than average 3 year old composition of the return in 2008.

Table 3. Catch of summer Chum salmon by statistical area for commercial, research and test fishing vessels [1] (July through the second week of September) 2000–2009.

Year	Statistical Weeks	Pacific Fishery Management Area					
		18	19	20	21	29 [2]	Total
2000	7/1–9/2	0	0	37	0	72	109
2001	7/1–9/2	0	0	26	0	77	103
2002	7/1–9/2	0	0	37	0	197	234
2003	7/1–9/2	0	0	27	0	54	81
2004	7/1–9/2	0	0	17	0	686	703
2005	7/1–9/2	0	0	0	0	115	115
2006	7/1–9/2	0	0	52	0	419	471
2007	7/1–9/2	0	0	0	0	49	49
2008	7/1–9/2	0	0	0	0	67	67
2009	7/1–9/2	0	0	0	0	27	27
Area Total		0	0	196	0	1,763	1,959

(1) Catches do not include PSC test fisheries
(2) Majority of this catch is fresh water based

The following sections describe the fisheries directed at fall Chum salmon in each of the Southern B.C. areas in 2009.

3.4.1 Johnstone Strait

In 2009, the Johnstone Strait Chum test fishery, which consisted of two purse seine vessels fishing on a daily basis from late September until late October, was pivotal in establishing run-timing, stock structure and, along with the initial commercial fishery openings, that Inside Southern Chum salmon exceeded the 1.0 million critical level.

As a result, competitive purse seine and gillnet fisheries were conducted based on the pre-season plan. Modifications to the purse seine and gillnet plans were made in-season to account for variation in effort participation compared to the pre-season expectations. Table 4 outlines the duration of fishery openings during the 2009 season.

There were five competitive commercial Chum salmon fisheries in Johnstone Strait (Area 12 & 13) in 2009 and one troll individual transferable quota (ITQ) fishery (Table 5).

The total 2009 commercial catch for Johnstone Strait was 516,000 Chum salmon (Table 5). There were no directed commercial Chum salmon fisheries in terminal areas of Johnstone Strait. In addition, First Nation FSC harvest in Johnstone Strait was estimated at 13,000. Unlike previous years, there was no recreational catch monitoring program in Johnstone Strait during the month of October so no estimate of Chum harvest is available for the recreational sector. The previous 9 year average (2000–2008) was 7,000 Chum harvested.

Table 4. Commercial fishery openings (in hours) directed at Chum salmon in Johnstone Strait (Area 12 & 13), 2009.

Year	Statistical Week	Pacific Fishery Management Area					
		12			13		
		Seine	Gillnet	Troll [1]	Seine	Gillnet	Troll [1]
2009	10-1		41			41	
	10-2	12	41		12	41	
	10-3						
	10-4	10	49		10	49	
Totals		22	131		22	131	

(1) The troll fishery was opened from Sep. 28 to Oct. 11 and Oct. 13 to Nov. 5. The fishery was an effort quota over that time period.

Table 5. Estimated Chum salmon harvest from commercial Chum salmon fisheries in Johnstone Strait, 2009.

Gear Type	Fishery Dates		Fishery Duration (hours)	Estimated Harvest [1]
	Start	End		
Purse Seine (Test)	Sep. 20	Oct. 26	n/a	1,000
Gillnet	Sep. 30	Oct. 2	41	28,000
Purse Seine	Oct. 5	Oct. 5	12	173,000
Gillnet	Oct. 8	Oct. 10	41	64,000
Purse Seine	Oct. 18	Oct. 18	10	149,000
Gillnet	Oct. 22	Oct. 24	49	35,000
Troll	Sep. 28	Oct. 11	n/a	29,000
Troll	Oct. 13	Nov. 5	n/a	37,000
Total				516,000

(1) rounded to the nearest 1000.

3.4.2 Strait of Georgia

All mid-Vancouver Island (Area 14) commercial fisheries occurred in the area surrounding Puntledge River. There were no openings in the Big and Little Qualicum river areas. In 2009, the gillnet openings occurred on October 13–16, 19–21, 22–23, October 29–November 1 and November 3–5. There was a total of 11 days fished for a harvest of 46,600 Chum. The troll fishery opened from October 13 to November 6 in the same area as for the gill net fishery; there was very little effort and no Chum harvested in this fishery in 2009. Purse seine fishing occurred from October 28 to November 1 and from November 3 to 5 with a total harvest in 2009 of approximately 2,000 Chum.

No commercial fisheries occurred in Jervis Inlet (Area 16) in 2009.

In Nanaimo (Area 17) two gill net openings occurred for 48 hours on November 1 and November 7 in 2009 with a total estimated harvest of 6,800 Chum.

In Cowichan (Area 18) there were 3 gill net openings in 2009 that occurred on November 10, 11 and the 16 for 12 hours. The total estimated harvest was approximately 3,700 Chum.

In Saanich Inlet (Area 19), there were no commercial fisheries conducted in 2009 as there was no surplus identified.

A purse seine test fishery occurred between October 27 and December 1 for 12 days in both Cowichan and Saanich areas in 2009.

The recreational creel survey extends from the marine area of Discovery Passage to Saanich Inlet. The total recreational harvest estimate was approximately 100 Chum; however, a survey was not conducted in this area after September 2009.

The harvest by First Nations in the Strait of Georgia in 2009 was estimated to be approximately 9,800 Chum (commercial and FSC).

3.4.3 Fraser River

Commercial fisheries in the lower Fraser River below Mission (Area 29) were closed from September 8 to October 9 to protect Interior Fraser Coho. Further restrictions on commercial fisheries were in place until late October to protect Interior Fraser steelhead. Due to these constraints, only one Area E (gill net) commercial opening took place in Area 29 during the 2009 fishing season. This opening occurred on October 27 for 24 hours in portions of Area 29. The total catch from this opening was estimated at 42,000 Fraser Chum salmon.

FSC gill-net fisheries commenced October 10th below Mission (Area 29) following closures to protect co-migrating Interior Fraser Coho. The estimated harvest from all FN fisheries in Area 29 and Region 2 (below Sawmill Creek) to the end of November was 81,275 Chum salmon. This includes an estimated 13,118 and 68,157 Chum salmon harvested in FN FSC & economic opportunity (E.O.) fisheries, respectively. Additionally, there were 8,458 Chum salmon reported harvested through excess salmon to spawning requirements (ESSR) opportunities in the lower Fraser River.

The lower Fraser River mainstem recreational fishery was open to the retention of Chum salmon from May to December with a bag limit of 2 Chum per angler per day in Area 29 and Region 2. In 2009, this mainstem fishery was assessed from May 1 to October 15; estimates of 43 and 890 Chum were harvested and released, respectively.

Tributaries to the lower Fraser River in Region 2 also support recreational fisheries catching Fraser Chum. The Chilliwack River recreational fishery was open to the retention of Chum salmon from July 2009 to December 2009. This fishery was assessed from September 15 to

November 15 in 2009; estimates of 2,404 and 11,238 Chum were harvested and released, respectively. The Harrison River recreational fishery was open to the retention of Chum salmon year round. In 2009, an assessment was conducted from September 1 to December 15; estimates of 742 and 8,843 Chum were harvested and released, respectively. Although historically not directed at Chum, a recreational fishery on Nicomen Slough was open to the retention of Chum salmon year round. The Nicomen Slough/Norrish Creek recreational fishery was assessed from October 10 to November 30 in 2009. Estimates of 10 and 1,117 Chum were harvested and released, respectively.

In total, for recreational fisheries assessed in Area 29 and Region 2 on the lower Fraser River and its tributaries in 2009, there were 3,199 Chum salmon harvested and 22,088 Chum salmon released.

3.4.4 West Coast Vancouver Island

In 2009, due to in-season assessment data that suggested a low abundance of wild and hatchery Chum stocks along the WCVI, commercial Chum salmon fisheries in Areas 23-25 did not occur.

First Nations FSC harvest of Chum salmon in Areas 23 & 25 totaled 2,200 Chum salmon in 2009. There were no FN ESSR fisheries in Areas 23, 24 & 25 in 2009.

3.4.3.1 Nitinat

The pre-season forecast for the 2009 return to the Nitinat watershed was 310,000 Chum salmon. Pre-season fishing plans were developed that maintained the measures listed above (with the exception of on-board observers). However, in-season assessment data suggested a low return of Nitinat Chum (i.e. the weekly escapement milestones were not achieved) and as a result, commercial gill net and purse seine fisheries in Area 21 did not occur in 2009 due to insufficient stock abundance.

First Nations FSC harvest of Chum salmon in Area 22 totaled 1,400 in 2009. First Nations also conducted ESSR fisheries in Nitinat Lake (Area 22) in 2009; harvest totaled 3,400 Chum salmon in this fishery (Table 6).

Table 6. Nitinat area harvest, broodstock and spawning escapement, 2000–2009.

Year	Area 21		Area 22	
	Seine Harvest	Gillnet Harvest	In-Lake Harvest & Broodstock	Natural Spawners
2000	0 *	0 *	11,000	22,000
2001	65,000 *	61,000 *	184,000 *	317,000 *
2002	466,000	81,000	131,000 *	38,000 *
2003	265,000	190,000	78,000	248,000 *
2004	72,000	156,000	166,000	247,000 *
2005	385,000	294,000	237,000	316,000 *
2006	224,000	230,000	145,000	155,000 *
2007	0	180,000	22,000	116,000
2008	19,000	25,000	29,000 *	53,000 *
2009	0	0	31,000	54,000
Average	147,000	122,000	103,000	157,000

* changed from the 2008 Post Season Summary Report (TCCHUM 10-2).

3.5 Escapement

Chum salmon that escape the commercial, First Nations, recreational and test fisheries form the gross escapement of spawning Chum salmon. This gross escapement is made up of Chum salmon that spawn in wild areas, those that are spawned in enhancement facilities, and those that are surplus to spawning requirements (ESSR) and are removed from the spawning areas. Gross escapement estimates are used in reconstruction of the total run size in a given year.

Some river systems support summer Chum salmon populations. These are relatively minor stocks and because of their distinctively early run timing (e.g. July to late August in Johnstone Strait) they are not included in the escapement total for fall Chum salmon.

3.5.1 Inside Southern

The primary enhanced escapement areas are presently limited to the mid-Vancouver Island, Squamish River, Burrard Inlet and Fraser River areas. The enhancement facilities in the mid-Vancouver Island consist of Big Qualicum, Little Qualicum and Puntledge River Hatcheries. There is one enhancement facility in the Burrard Inlet (Capilano River Hatchery: limited Chum salmon hatchery enhancement), and the Squamish watershed (Tenderfoot Creek Hatchery) and four in the Fraser River watershed (Inch Creek, Chilliwack River, and Chehalis River Hatcheries and Weaver Creek Spawning Channel). Enhancement on the Capilano is opportunistic only using Chum salmon that return to the hatchery facility for broodstock.

The stocks which are managed within the context of the Inside Southern Chum salmon plan are the fall Chum salmon. These Chum salmon enter Johnstone Strait during the September to November time period. Escapement estimates, for these Chum salmon since 2000, are presented in Table 7.

Table 7. Inside Southern Chum salmon spawning escapement estimates for wild and enhanced groupings (Fraser and Non-Fraser) for 2000–2009 [1].

Grouping	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Fraser (Wild + Enhanced)	667,730	3,018,902	2,243,216	1,451,961	2,633,549	1,264,071	2,026,673	1,026,701	940,163	619,686
Non-Fraser (Wild + Enhanced)	304,593	1,095,473	1,246,208	777,956	1,010,295	558,309	747,654	815,540	708,667	819,560
Total	972,323	4,114,375	3,489,424	2,229,917	3,643,844	1,822,380	2,774,327	1,842,241	1,648,830	1,439,246

(1) Does not include Chum salmon which are surplus to facility requirements and are removed from the spawning areas as they do not contribute to production in subsequent years. Those Chum salmon are identified as rack and assigned as catch.

3.5.2 West Coast Vancouver Island

Overall, the WCVI escapements were low. Nitinat spawning escapements were estimated at 54,000, which is the 4th lowest since 2000 (Table 6). Other estimates of escapements on the WCVI were consistent with the low Nitinat returns.

4. UNITED STATES STOCKS AND FISHERIES

4.1 Washington Run Sizes, Catches, and Spawning Escapements

Tables 8 through 10 provide the pre-season forecasts of run size, post-season estimates of spawning escapement and the total run size for the Chum salmon runs returning to Puget Sound and coastal Washington areas. The tables provide estimates for three major groupings which are defined by their return timings (summer, fall, and winter Chum salmon).

Summer Chum salmon 2009 pre season forecasts for Puget Sound totaled approximately 81,000 fish, which is slightly below the average return for the recent 10-year period. The post-season assessment of Puget Sound summer Chum in 2009 was approximately 38,000 fish, or 48% of the preseason forecast, and the lowest overall Puget Sound summer Chum return since at least 2000. The Hood Canal summer Chum post-season run size of 8,400 was the lowest since at least 2000, and was only 46% of the preseason forecast (Table 8).

Fall Chum salmon 2009 pre-season forecasts for Puget Sound totaled approximately 915,000 fish, or approximately 120% of the 2000–2008 average run size. The post-season assessment of Puget Sound fall Chum salmon was approximately 98% of the forecasted levels overall, with individual regional post-season numbers ranging from 41% (Stillaguamish/Snohomish) to 119% (Hood Canal) of the pre-season forecasted numbers. The Stillaguamish/Snohomish run size of 38,000 and the Skagit run size of 29,000 were both the lowest observed for their respective river systems since at least 2000 (Table 9).

The winter Chum salmon 2009 preseason forecast for South Puget Sound was approximately 83,000 fish, or 80% of the 2000–2008 average run size. The post-season assessment of this run was approximately 46,000 fish, or 43% of the pre-season forecast number (Table 10).

Table 11 provides Chum salmon catch information from the Strait of Juan de Fuca (SJF) fisheries in Areas 4B, 5, and 6C and the San Juan Islands/Point Roberts (SJI/PR) fisheries in Areas 7 and 7A (Appendix 2). The table also includes annual Chum salmon harvest totals for the Puget Sound and the Washington Coastal areas.

Paragraph 3 of the Chum Annex requires that Canada and the United States assess catch levels of summer Chum salmon caught during the August 1 through September 15 time-period in boundary area fisheries. Table 12 provides Chum salmon catch during the summer Chum salmon accounting period for U.S. boundary area fisheries.

Table 8. Washington summer Chum salmon pre-season and post-season estimates of abundance and estimated spawning escapements (2000–2009). (Source: V. Tribble, T. Johnson, WDFW, Jan. 2011).

Region	Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Strait of Juan de Fuca	Pre-Season	792	941	1,468	3,131	4,739	6,803	8,238	8,566	5,969	5,198
	Post-Season	987	3,982	6,981	7,016	9,360	9,734	8,281	3,320	3,561	5,115
	Escapement	983	3,955	6,955	6,959	9,341	9,682	8,246	3,295	3,521	5,115
Hood Canal	Pre-Season	6,988	6,871	7,846	10,128	18,078	18,060	19,780	23,729	20,159	18,009
	Post-Season	9,506	13,375	13,170	36,024	95,077	16,165	29,395	12,788	17,570	8,371
	Escapement	8,649	12,044	11,454	35,696	69,995	15,757	26,753	10,781	15,403	7,423
South Puget Sound[1]	Pre-Season	84,867	75,599	155,000	47,788	99,317	38,334	55,300	39,840	64,229	57,352
	Post-Season	39,028	84,111	58,545	49,817	178,199	44,993	78,797	57,786	32,065	25,010
	Escapement	27,705	62,821	46,798	45,945	120,782	24,701	63,345	52,661	20,855	21,661

[1] South Puget Sound estimates include only commercial catch and escapement within Puget Sound.

Table 9. Washington fall Chum salmon pre-season and post-season estimates of abundance and estimated spawning escapements (2000–2009). (Source: B. McClellan, WDFW, for Willapa Bay; C. Ashbrook, WDFW, for Grays Harbor, V. Tribble, WDFW, for other areas; January 2011).

Region	Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Willapa Bay	Pre-Season	69,188	53,958	79,892	75,817	79,183	63,441	38,754	23,798	40,022	7,139
	Post-Season	46,940	53,545	92,520	84,772	114,756	28,132	23,140	17,542	12,802	17,437
	Escapement	40,281	29,970	60,093	47,797	84,926	11,983	14,907	17,256	9,331	12,743
Grays Harbor	Pre-Season	32,000	20,238	35,773	66,312	45,352	38,038	29,370	12,000	9,903	17,665
	Post-Season	10,780	27,238	66,317	49,784	34,274	20,596	15,786	12,167	8,879	13,359
	Escapement	8,936	26,193	57,526	38,813	17,494	13,483	11,268	11,342	6,249	8,799
Strait of Juan de Fuca	Pre-Season	2,823	1,841	1,761	2,494	2,438	3,460	3,830	2,143	2,745	2,587
	Post-Season	269	1,737	4,890	1,177	3,232	2,382	1,567	769	841	1,462
	Escapement	219	1,562	4,603	1,071	2,739	2,034	1,313	503	454	1,305
Nooksack / Samish	Pre-Season	95,598	82,431	171,000	81,921	78,484	126,869	135,100	19,414	130,070	69,145
	Post-Season	18,866	133,200	109,614	133,654	89,894	67,657	66,602	48,631	27,471	32,007
	Escapement	5,244	75,919	86,284	112,683	53,563	44,512	29,289	21,571	16,257	26,268
Skagit	Pre-Season	168,000	45,875	304,049	52,410	109,715	25,695	164,094	90,481	132,036	26,828
	Post-Season	41,570	97,045	406,476	37,210	171,187	53,652	213,468	37,627	29,946	29,477
	Escapement	22,377	73,175	210,028	18,017	150,196	34,600	105,239	19,576	22,067	26,744
Stillaguamish / Snohomish	Pre-Season	184,867	113,600	685,100	245,246	264,542	225,113	445,800	287,993	229,251	92,477
	Post-Season	55,252	361,843	691,205	214,569	382,831	84,791	479,890	235,799	125,064	37,689
	Escapement	39,050	85,119	377,481	172,354	212,463	38,787	272,925	43,664	38,553	29,378
South Puget Sound	Pre-Season	402,000	363,090	241,500	448,365	470,048	655,742	466,700	408,040	686,511	348,333
	Post-Season	247,776	972,934	970,199	742,798	1,022,643	414,939	939,454	1,036,773	464,193	344,850
	Escapement	105,857	313,570	320,817	316,816	356,712	137,442	369,035	368,849	152,549	150,732
Hood Canal	Pre-Season	624,623	353,949	446,616	342,061	501,100	749,593	668,400	587,155	668,397	374,929
	Post-Season	153,474	802,605	998,726	1,275,139	1,192,852	356,281	774,893	677,761	553,122	446,476
	Escapement	63,170	257,770	368,854	331,378	229,893	100,242	185,875	162,425	71,925	55,879

Table 10. Washington winter Chum salmon pre-season and post-season estimates of abundance and estimated spawning escapements (2000–2009). (Source: V. Tribble, WDFW, January 2011).

Region	Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
South Puget Sound	Pre-Season	33,568	54,631	11,700	34,575	76,464	142,406	149,200	81,065	98,922	83,380
	Post-Senson	14,532	163,610	237,635	53,112	134,002	72,730	75,833	105,933	89,271	35,544
	Escapement	8,726	139,046	206,469	49,050	98,580	43,908	58,786	73,442	45,162	15,486

Table 11. Harvest of summer, fall, and winter Chum salmon in SJF, SJI/PR, Puget Sound and Washington coastal areas (2000–2009)[1].

Region	2000	2001	2002	2003	2004	2005	2006	2007	2008[1]	2009[1]
SJF	5,677	10,400	1,818	516	5,384	2,086	4,751	6,998	6,083	884
SJI/PR	428	3,281	111,864	84,190	166,466	77,606	109,223	27,397	75,719	24,348
Puget Sound[2]	307,198	1,581,793	1,769,675	1,389,178	2,075,556	668,181	1,596,077	1,452,669	962,563	637,553
WA Coast[3]	9,367	26,949	42,866	50,752	48,739	24,223	13,781	2,729	7,345	10,671

[1]Includes recreational harvest; 2008, 2009 harvest estimates are preliminary (from E.Kraig, WDFW, January 2011)
[2]All other Puget Sound freshwater and marine catch areas except Strait of Juan de Fuca or San Juan Islands/Point Roberts Fisheries, (from TOCAS filled with LIFT query January 2011).
[3]Coastal Areas combine Catch Areas 1–4 including Grays Harbor, Willapa Bay, Columbia River and Coastal Rivers, (from TOCAS filled with LIFT query January 2011).

Table 12. Harvest of Chum salmon in the Strait of Juan de Fuca and the San Juan Islands' commercial fisheries during the summer Chum salmon accounting period (2000–2009).

Periods:	7/1–8/8[1]	8/9–8/15	8/16–8/22	8/23–8/29	8/30–9/5	9/6–9/15
95–97 GSI[2]	0.68	0.68	0.397	0.45	0.14	0.07
2000	14	0	1	0	0	0
2001	25	0	0	0	0	0
2002	38	11	0	0	0	8
2003	179	102	123	4	0	12
2004	139	25	0	15	31	25
2005	9	13	10	31	14	104
2006	12	54	75	25	3	30
2007	34	5	0	0	0	9
2008	240	0	1	0	0	29
2009	13	0	0	0	5	69

[1]Indicates cumulative catch through this period (from TOCAS filled with LIFT query January 2011).
[2]Proportion of Hood Canal/Strait of Juan de Fuca summer Chum salmon from GSI samples from 1995–1997.

4.2 United States Strait of Juan de Fuca Fisheries (Areas 4B, 5, 6C)

4.2.1 Management Intent

During the 2009 season the management strategy for the Strait of Juan de Fuca fishery consisted of limiting the total effort in this fishery and basing management decisions on the needs of Puget Sound stocks of Chum salmon. The regime of this fishery has been maintained by limiting access to four Treaty Indian tribes using only gillnet gear.

This fishery has been constrained by low catch rates, low market prices, and inclement weather conditions, resulting in relatively modest catch levels over the period of 2000–2009 (Table 11). The catch in 2009 decreased substantially from the 2008 level. Catch and effort for the 2000–2009 period was well below levels observed in the late 1980s and early 1990s.

4.2.2 Fishery Description

As in previous years, the Chum salmon fishery in Areas 4B, 5 and 6C was restricted to Treaty Indian fishers using gill nets. The fall Chum salmon fishery opened the week of October 11, with a schedule of six days per week and continued through November 14, except for a two-day closure, November 1 and 2, to review catches. A total of 524 Chum salmon was harvested.

Incidental catches of Chum salmon, prior to the directed fishing season, were low in 2009, primarily due to the limited effort and open periods, during the passage of summer Chum salmon and the early portion of the fall run, which overlaps the Coho salmon season. Only 18 summer Chum salmon, including those caught in test fisheries, were recorded through September 15. During the subsequent Coho-directed fishery, an additional 32 Chum salmon were caught. During the fall Chum salmon fishery, 524 Chum salmon were harvested from October 11 to the end of the season, resulting in an annual catch total of 574 for the Strait of Juan de Fuca.

4.3 San Juan Islands / Point Roberts Fisheries (Areas 7 and 7A)

4.3.1 Management Intent

Chum salmon fisheries in Areas 7 and 7A were regulated in compliance with the provisions of Chapter 6 of Annex IV of the Pacific Salmon Treaty (Appendix 1). This chapter specifies a fixed harvest ceiling of 130,000 in U.S. Areas 7 and 7A, unless a critically low level of abundance is identified for the Chum salmon runs returning through Johnstone Strait or to the Fraser River. The Annex also specifies that directed fisheries for Chum salmon in Areas 7 and 7A will not occur prior to October 10 to protect Hood canal summer Chum salmon.

In 2009, Canada indicated, on the basis of Johnstone Strait test catches and fisheries, that the Inside Southern Chum salmon abundance was above the critical level. Subsequently, the in-season Fraser Chum salmon abundance estimate was 1.175 million, exceeding the 900,000 critical level. Therefore, the overall ceiling for this fishery in 2009 was 130,000.

4.3.2 Fishery Description

Non-Treaty reef net fisheries targeting marked Coho salmon were conducted from the end of Fraser Panel control (September 18) through October 9, with non-retention of Chum salmon. From October 10 through November 14 Chum salmon retention was allowed in this fishery, and 2,859 Chum salmon were harvested.

The Treaty Indian gill net and purse seine fishery opened at the start of the fall Chum management period on October 10 for 38 hours and then again on October 14 for another 38 hours. On October 18 the fishery opened continuously through November 15. The Non-Treaty fleet opened for 4 days of combined gill net and purse seine fishing during the week beginning October 11, and then opened from October 20 through November 14.

There were 69 summer Chum salmon reported caught in Areas 7 and 7A prior to September 16. The total Chum salmon catch by all gears in Areas 6, 7, and 7A, reported through November 14, was 24,245. Catch distribution, between Areas 7 and 7A, was 83.5% and 16.5% respectively. During the fall Chum fisheries in Areas 7 and 7A, there was a reported by-catch of 590 Coho salmon and zero steelhead.

5. STOCK IDENTIFICATION

5.1 Tagging of Adult Chum Salmon

No adult tagging projects were reported by either United States or Canada in marine or nearshore areas in 2009.

5.2 Coded Wire Tagging (CWT), Otolith and Fin Marking

United States

A summer Chum salmon supplementation program was started in 1992 at the Quilcene National Fish Hatchery to address severe declines in the numbers of summer Chum salmon returning to the Quilcene River and Hood Canal. In recent years, an adipose fin clip (with no CWT) was utilized to aid in identifying hatchery fish for terminal fisheries management and project evaluation purposes. Brood year 2003 was the final year summer Chum salmon were marked and released from the hatchery.

A number of other hatchery supplementation and re-introduction programs for summer Chum salmon in the Hood Canal and Strait of Juan de Fuca regions, and fall Chum salmon in the Lower Columbia have utilized otolith marks to aid in assessing the success of the programs and to determine the proportion of hatchery and natural origin fish on the spawning grounds (Table 13). Supplementation summer Chum salmon releases for recovery ended at Discovery, Chimacum, and Union with brood year 2003.

Table 13. Numbers of summer and fall Chum salmon released with otolith marks or adipose fin clipped, by brood year and location, 2002–2009. (Source: T. Johnson, J. Grimm, WDFW Feb. 2011).

Brood Year	Puget Sound Summer Chum								
	Jimmy comelately	Discovery Bay[1]	Chimacum[1]	Big Beef	Big Quilcene[2]	Hamma Hamma	Lilliwaup	Union[1]	Tahuya
2002	20,887	118,347	57,300	72,622	272,017	61,000	96,000	82,636	
2003	50,307	88,610	57,435	76,353	92,559	75,356	103,913	35,343	
2004	76,982			14,814		57,000	99,500		118,872
2005	57,300					117,837	106,466		119,260
2006	79,428					151,550	88,800		133,826
2007	73,840					48,530	0		53,632
2008	88,766					208,450	68,810		97,142
2009	92,200						140,210		69,711
	Puget Sound Fall Chum								
	Whatcom Creek								
2007	450,000								
2008	400,000								
2009	0								
	Lower Columbia River Fall Chum								
	Grays River Hatchery			Sea Resources Hatchery			Washougal Hatchery		
2002	398,000			84,818			218,283		
2003	357,000			102,132			75,952		
2004	163,000								
2005	155,501						19,578		
2006	129,427								
2007	77,609								
2008	104,600								
2009	300,000						70,000		

[1]Salmon and Snow creek is Discovery Bay combined, program discontinued after brood year 2003.
[2]Adipose fin clipped only—no otolith marks.

Canada

Thermal marking of otoliths has been used as a technique of mass marking hatchery raised salmonids in B.C. since 1992. The method involves manipulating the temperature of the rearing water by at least 2°C to induce a mark on the otolith. The change in water temperature can be accomplished through the use of two different water sources, through heating the water or by chilling it. By altering water temperatures over a period of time unique marks can be created. Thermal marking was first used on Chum salmon from Nitinat hatchery in 1993 and continues to be used as a means of estimating hatchery contribution to both fisheries and escapement (Table 14). Thermal marking is currently the only method of marking being applied to Chum salmon from Nitinat hatchery (due to the dropping of the Multiple Fin Clip program). Transplanting thermally marked Chum salmon into Klanawa River started with the 2001 brood and ended with 2006 brood year.

Table 14. Releases of thermally marked Chum salmon from WCVI based Canadian hatchery facilities, 2000–2009.

Brood Year	Hatchery Facility							
	Nitinat Release Sites		Conuma Release Sites					
	Nitinat River & Lake	Klanawa River	Conuma River	Conuma Estuary	Tlupana River	Sucowa River	Canton River	Deserted River
2000	5,153,902	0	543,511	1,296,654	998,400	139,090	1,009,746	269,284
2001	27,093,836	3,162,846	569,118	1,649,290	390,754	200,803	1,070,539	272,395
2002	22,757,842	2,915,502	0	1,792,758	1,038,542	445,007	892,140	341,635
2003	21,252,421	2,516,338	0	1,585,534	425,261	410,872	484,570	798,330
2004	32,684,608	2,631,539	0	1,882,230	932,556	1,023,658	679,554	0
2005	36,724,205	2,739,742	0	914,381	744,834	256,296	434,449	0
2006	26,323,943	2,585,428	0	1,455,119	1,139,028	181,333	133,731	0
2007	13,004,189	0	0	271,820	109,922	15,701	47,846	0
2008	7,631,058	0	0	1,011,562	254,905	292,430	418,655	0
2009	5,252,749	0	0	1,833,322	685,465	551,365	854,548	0

Conuma Hatchery first began thermal marking several stocks with the 1998 brood year. A comprehensive sampling program occurred during the fall Chum salmon fisheries and permitted a better understanding of timing and distribution of the different stocks in Nootka Sound.

Enhanced contributions of Chum salmon from major hatchery facilities are based on marking a portion of the fry released with an adipose clip and coded-wire tag (Ad-cwt) or a ventral fin clip with or without an adipose clip, and subsequent recovery of these marks in the commercial fishery and escapement programs. Released Chum salmon marked with fin clips include the Big Qualicum River (since 1964) and Little Qualicum River (1979–2002). Since egg and fry mortality generally is less than 10%, fry enumeration is considered very accurate. Not all release groups are represented by a mark. Contributions for those groups are estimated by associating them with a marked release group with a similar size and release timing. Tables 15 and 16 provide a summary of marks applied from 2000–2009 brood years.

Table 15. Releases of CWT (coded-wire tag) Chum salmon (and the associated unclipped releases) from southern B.C. based Canadian hatchery facilities, 2000–2009.

Brood Year	Hatchery Release Sites							
	Inch Creek				Sliammon River			
	CWT + Adipose clip	Adipose clip only	Unclipped	Total	CWT + Adipose clip	Adipose clip only	Unclipped	Total
2000	49,759	264	926,658	976,681	99,615	879	500,628	601,122
2001	49,931	100	1,124,599	1,174,630				

Table 16. Releases of marked Chum salmon (Clip Type-AD: adipose; LV: left ventral; RV: right ventral; AN: anal; D: dorsal) from southern BC based Canadian hatchery facilities, 2000–2009.

Stock	Brood Year	Clip Type	# Clipped	# Poor Clips / Unclipped	Total
Big Qualicum River	2001	ADRV	245,794	8,596	254,390
	2002	ADRV	252,260	10,359	262,619
	2003	ADRV	251,939	4,856	256,795
	2004	ADRV	261,366	6,579	267,945
	2005	ADRV	252,585	9,775	262,360
	2006	ADRV	252,016	6,853	258,869
	2007	ADRV	251,329	9,471	260,800
	2008	ADRV	204,801	5,409	210,210
	2009	ADRV	250,692	8,381	259,073
Comma River	2000	ADLV	97,906	4,720	102,626
	2001	ADLV	102,059	4,018	106,077
Deserted/NWVI	2000	RV	76,928	1,174	78,102
Little Qualicum River	2001	ADLV	266,330	7,874	274,204
	2002	ADLV	249,887	120	250,007
Salloomt River	2001	LV	97,015	4,595	101,610
	2002	LV	100,637	4,742	105,379
	2003	LV	103,148	1,054	104,202
Theodosia River	2002	LV	101,029	0	101,029
Sucwoa River	2000	LV	76,400	0	76,400
	2001	LV	76,516	0	76,516
Sugsaw Creek	2000	LV	13,000	0	13,000
	2001	LV	31,000	0	31,000
	2002	LV	11,000	0	11,000
	2003	LV	11,000	0	11,000
	2004	LV	20,600	0	20,600

5.3 Genetic Stock Identification

In 2008 and continuing through 2009, the Committee began to develop a joint recommendation to the Southern Panel concerning the type of stock identification methodology to be used for immediate and future application of Canada and United States (U.S.) Chum salmon stock assessment. Under the Pacific Salmon Treaty (Annex IV, Chapter 6, Section 2):

> *"When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods."*

Fisheries of interest include Canadian fisheries (Johnstone Strait, Qualicum, Fraser River, and Nitinat) and U.S. fisheries (Point Roberts, San Juan Islands and the Strait of Juan de Fuca).

The committee reviewed a number of new publications concerning the population genetics and mixed stock fisheries of Chum salmon. Reports of regional variability in microsatellite (mSAT)

markers covered Puget Sound (Winans et al. 2008) and Japan (Beacham et al. 2008a). Pacific rim baselines for mSATs were published by Beacham et al. (2008b, 2009) and for mitochondrial variation (mtDNA) by Yoon et al. (2008). The power to discriminate among stocks in mixture scenarios using mSATs and single nucleotide polymorphisms (SNPs) was evaluated by Beacham et al. (2008b) and in Smith and Seeb (2008). Moriya et al. (2009) and Yoon et al. (2009) conducted mixed stock fishery analysis in the North Pacific Ocean using mtDNA and mSAT characters respectively.

5.3.1 Fishery Sample Collection for DNA Stock Identification.

United States

Among focused studies, WDFW continued its use of GSI techniques to distinguish supplementation-origin from natural origin adult summer Chum salmon in Hood Canal. In particular, mSAT DNA data were used to clarify the uncertain hatchery assignments generated from otolith thermal marks. For instance, in 2009, WDFW used genetic techniques to clarify otolith marking data in the monitoring of Hood Canal summer Chum salmon supplementation projects. All returning supplementation origin summer Chum salmon were otolith marked, but there was ambiguity between marks for some programs, meaning that fish could be identified as supplementation or natural origin, but some supplementation fish could not be identified to their program of origin. Where possible, analysis of DNA samples from fish with ambiguous marks was used to identify fish to the program of origin. WDFW also conducted a juvenile stock assignment study in the Strait of Juan de Fuca and Hood Canal during 2009. This study focused mainly on documenting the emigration timing and relative production patterns of summer and fall Chum salmon in key populations.

Additionally, 427 tissue samples were collected near Apple Cove Point in Puget Sound Area 9, on October 29, November 4, and November 12 as the fourth year of Chum salmon DNA collection from this test fishery.

No Chum salmon DNA samples were collected in 2009 for stock identification purposes during the Chum directed commercial fisheries occurring Areas 7 and 7A.

Canada

GSI samples were collected during the Johnstone Straits purse seine fisheries in 2009. A summary of historic Chum salmon GSI sampling is presented in Table 17.

Table 17. Number of Chum salmon sampled for GSI data, Johnstone Strait, 2000–2009.

Year	Johnstone Strait	
	Commercial Samples	Test Fishery Samples
2000	300	0
2001	300	0
2002	0	0
2003	600	100
2004	600	0
2005	0	0
2006	720	0
2007	858	0
2008	865	0
2009	789	1000

5.3.2 Baseline Collection for DNA Stock Identification.

5.3.2.1 United States

During 2009, WDFW continued its baseline sampling of relevant Washington State populations of Chum salmon (Table 18). In total, 730 fin tissues were collected from 16 locations. While more than half of these samples were from the Columbia River. Several locations in Hood Canal and the Strait of Juan de Fuca were also sampled. Fin tissues were clipped and stored for future analyses of DNA-based genetic variation.

Table 18. Chum salmon genetics tissue collections from Washington and Oregon in 2009.

Code	Collection Name / Locality	Origin	N
09DQ	NBK-Bangor, juvenile Chum salmon BY-2008	Summer natural	123
09DW	Duckabush River Chum juveniles SU or F?	unknown	46
09GY	Cowlitz River, Chum, salmon hatchery separator	natural	7
09HH	Jimmycomelately Creek adult summer Chum	Mixed[1,2]	106
09HI	Salmon Creek adult summer Chum	Summer natural	48
09HJ	Snow Creek adult summer Chum	Summer natural	27
09HK	Chimacum Creek adult summer Chum	Summer natural	28
09HN	Dosewallips River adult summer Chum	Summer natural	42
09HO	Duckabush River adult summer Chum	Summer natural	41
09HP	Hamma Hamma River adult summer Chum	mixed[2]	83
09HS	Union River adult summer Chum	Summer natural	74
09HT	Tahuya River adult summer Chum	mixed[2]	4
09JK	Skamokawa Creek	natural	2
09JM	Hamilton Creek	natural	66
09JN	Hamilton Creek Springs (28.03031)	natural	93
09JO	Hardy Creek	natural	32
09KH	Multnomah Falls Area, mainstem Col. R. spawning	natural	45
09KI	Ives Island Complex, mainstem Col. R	natural	80
09KJ	Washougal Hatchery (Ives, Multnomah, St. Cloud, Horsetail)	natural	22
09KK	I-205 (Woods Landing & Rivershore) adult Chum salmon	natural	100
09KL	St. Cloud Area, mainstem Col. R spawning	natural	11
09KM	Horsetail Falls, OR, mainstem Col. R. spawning (Rm 138.5)	natural	6
09KN	Big Creek Hatchery adult Chum salmon	natural	22
09KO	Main Grays & WF Grays & Crazy Johnson Cr.	natural	99
09KR	Duncan Creek. spawning channels adult Chum salmon	natural	50
09KX	Deep River SAFE fishery	natural	1
09LE	Grays River Fall adult Chum salmon	natural	108
09MB	Chinook River Fall adult Chum salmon, Stream survey	natural	4
		TOTAL	1,370

[1]30% wild.
[2]Mixed = majority wild.

5.3.2.2 Canada

CDFO continues to collect baseline samples of southern British Columbia Chum populations (Table 19). In total, 303 tissues were collected from 3 locations. These samples have been incorporated into the CDFO mSAT baseline.

Table 19. Chum salmon genetics tissue collections from Southern BC in 2009.

Collection Name / Locality	Origin	N
Qualicum River	Mixed[1]	61
Little Qualicum River	Mixed[1]	69
Puntledge River	Mixed[1]	173
Squawkum Creek	Mixed	219
Barnes Creek	Wild	2
Worth Creek	Mixed	48
Peach Creek	Mixed	71
Hopedale Creek	Mixed	36
Hicks Creek	Mixed	53
Kawkawa Creek	Wild	3
Blaney Creek	Wild	119
Kanaka Creek	Wild	86
Silverdale Creek	Wild	108

[1]Mixed = majority hatchery.

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APPENDIX 1:

ANNEX IV, CHAPTER 6, OF THE PACIFIC SALMON TREATY

Southern British Columbia and Washington State Chum Salmon

The provisions of this Chapter shall apply for the period 2009 through 2018.

1. The Parties shall maintain a Joint Chum Technical Committee ("the Committee") reporting, unless otherwise agreed, to the Southern Panel and the Commission. The Committee will undertake to, *inter alia*:

   (a) maintain and present historical and escapement information for stocks relevant to the Treaty;

   (b) utilize available information to estimate and document stock composition and exploitation rates in fisheries of concern to the Treaty;

   (c) review annually the Parties' assessment of stock status and fisheries activities for Chum fisheries of concern to the Treaty;

   (d) identify high priority research and information needs for the Parties, including fishery and escapement monitoring and assessment, stock identification, and enhancement; and

   (e) periodically and/or when requested;

      i. Exchange available information on the productivity and escapement requirements of stocks relevant to the treaty;

      ii. Identify and document stocks of concern (with respect to conservation) relevant to the treaty;

      iii. Evaluate the effectiveness and performance of management strategies; and

      iv. Evaluate the effectiveness of alternative regulatory and production strategies recommended by the Parties.

2. When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods.

3. Canada and the United States shall assess catch levels and make attempts to collect additional genetic samples from any Chum salmon caught during the July 1 through September 15 time period in the boundary area fisheries (U.S. Areas 4B, 5, 6C, 7 and 7A; Canadian Areas 18, 19, 20, 21, and 29).

4. During the period from July 1 through September 15, Canada will require the live release of Chum salmon from all purse seine gear fishing in the Strait of Juan de Fuca (Canadian Area 20) and the United States will require the same for the non-Indian seine fisheries in Areas 7 and 7A. Note: By U.S. regulation, purse seine fisheries are not permitted in U.S. Areas 4B, 5 and 6C.

5. Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries to provide continued rebuilding of depressed naturally spawning Chum salmon stocks, and, to the extent practicable, not increase interceptions of U.S. origin Chum salmon. Terminal fisheries conducted on specific stocks with identified surpluses will be managed to minimize interception of non-targeted stocks.

6. Canada will manage its Johnstone Strait mixed stock fishery as follows:

   a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical.

   b) For run sizes above the critical threshold, Canada will conduct fisheries with an exploitation rate of up to 20% in Johnstone Strait of Inside Southern Chum salmon; and.

   c) When run sizes are expected to be below the critical threshold, Canada will notify the United States and will only conduct assessment fisheries and non-commercial fisheries. Commercial fisheries targeting Chum salmon will be suspended

7. Canada will manage its Fraser River fisheries for Chum salmon as follows:

   a) For Fraser River terminal area run sizes, identified in-season, at abundance levels lower than 900,000 Chum salmon, the Canadian commercial Chum salmon fisheries within the Fraser River and in associated marine areas (Area 29), will be suspended; and

   b) For Fraser River terminal area run sizes, identified in-season at levels greater than 900,000 Chum salmon, Canadian commercial Chum salmon fisheries within the Fraser River, shall be guided by the limits of the in-river Total Allowable Catch set by Canada.

8. Canada will manage the Nitinat gill net and purse seine fisheries for Chum salmon to minimize the harvest of non-targeted stocks.

9. Canada shall conduct a genetic sampling program of Chum salmon taken in the West Coast Vancouver Island troll fishery if early-season catch information indicates that catch totals for the July 1 through September 15 season may reach levels similar to 1985 and 1986. Sampling, should it occur, will include catches taken from the southern areas (Canadian Areas 121-124).

10. The United States will manage its Chum salmon fishery in Areas 7 and 7A as follows:

a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical.

b) For run sizes below the critical threshold, the U.S. catch of Chum salmon in Areas 7 and 7A shall be limited to Chum salmon taken incidentally to other species and in other minor fisheries, but shall not exceed 20,000, provided that catches for the purpose of genetic stock identification sampling shall not be included in the aforementioned limit;

c) For run sizes above the critical threshold, the base catch ceiling for the U.S. Chum salmon fisheries in Areas 7 and 7A will be 130,000 Chum salmon;

d) Canada will provide a run size estimate of Chum salmon entering the Fraser River no later than October 22. If the estimate is less than 900,000, the U.S. will limit its fishery impacts on Fraser River Chum salmon by restricting catch in Areas 7 and 7A to not exceed 20,000 additional Chum from the day following the date the U.S is notified. The total catch is not to exceed the catch ceiling of 130,000 Chum salmon;

e) U.S. commercial fisheries for fall Chum salmon in Areas 7 and 7A will not occur prior to October 10;

j) The U.S. will manage the Areas 7 and 7A fisheries for Chum salmon with the intent to minimize the harvest of non-targeted species;

k) No U.S. catch shortfalls may be accrued; however any overages shall be carried forward as indicated in (h) and (i);

l) Due to management imprecision, a catch in the U.S. of up to 135,000 Chum salmon will not result in an overage calculation. Catches in excess of 135,000 Chum salmon shall result in an overage being calculated by subtracting 130,000 from the total Chum catch. Overages will be accounted for by reducing the U.S. annual catch ceiling in up to two subsequent non-critical Inside Southern Chum salmon years; and

m) From the day following the date the U.S. is notified of a run size below the critical threshold as defined in 10(b) or (d), any catches in excess of 20,000 Chum salmon will result in an overage. Overages will be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern Chum salmon years.

11. The United States shall conduct its Chum salmon fishery in the Strait of Juan de Fuca (United States Areas 4B, 5, and 6C) so as to maintain the limited effort nature of this fishery, and, to the extent practicable, not increase interceptions of Canadian origin Chum

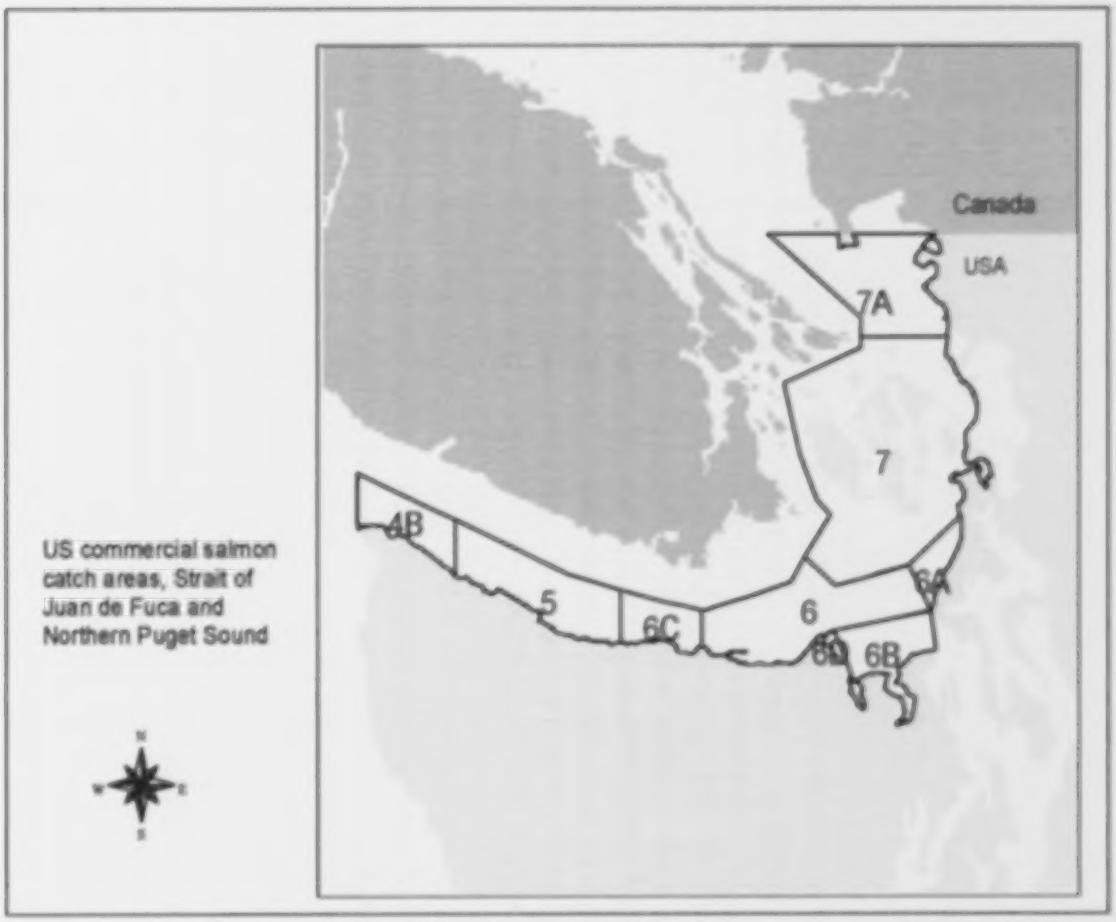
salmon. The United States shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

12. All information concerning by-catch of other salmon species from the Chum salmon fisheries covered by this chapter will be shared between the Parties in the annual Post Season Report.

13. Should circumstances arise that are inconsistent with either Parties understanding of the intent of the chapter, the Southern Panel will discuss the matter postseason and explore options for taking the appropriate corrective actions.

APPENDIX 2

UNITED STATES AND CANADIAN STATISTICAL AREA MAPS



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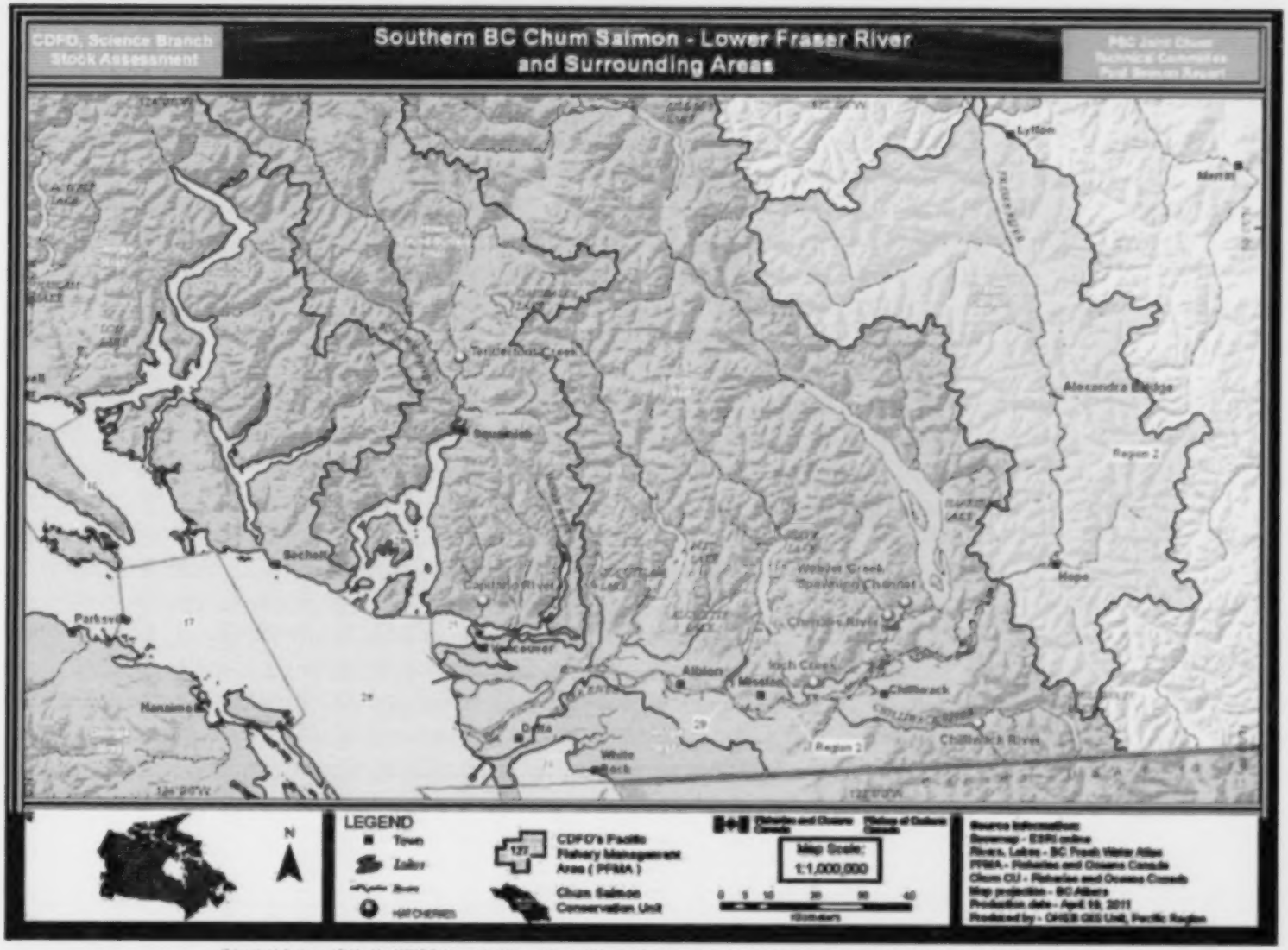

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APPENDIX 3:

JOINT DIRECTION ON CHUM SALMON STOCK IDENTIFICATION METHODS, JANUARY 2010

Joint Direction on Chum Salmon Stock Identification Methods

January 2010

Submitted by: Bilateral Chum Technical Committee

Goal

Provide a joint direction to the Southern Panel concerning the type of stock identification methodology to be used for immediate and future application of Canada and United States (U.S.) Chum stock assessment. Under the Pacific Salmon Treaty (Annex IV, Chapter 6, Section 2):

> *"When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods."*

Fisheries of interest include Canadian fisheries (Johnstone Strait, Qualicum, Fraser River, Nitinat, and WCVI) and U.S. fisheries (Point Roberts, San Juan, Strait of Juan de Fuca and Washington Ocean).

Introduction

Historically, Canada and the U.S. have utilized a number of stock identification methodologies. There are two general types of marking, applied markers and natural markers. These have included:

Applied Markers

- Coded wire tags (CWT) – While successful for chinook and Coho, survival and returns of tagged Chum fry has been poor. This application is limited primarily to hatchery fish and extraction of the tag is lethal.
- Fin clips – Similar to CWT application, this is limited primarily to hatchery fish and can also reduce fry survival. Marking is constrained by the number of available fin clip combinations.
- Thermally induced otolith marks – This technique is currently used by numerous hatcheries in WCVI and in Puget Sound recovery supplementation programs. Limited to hatchery fish, sampling and processing is costly and otolith extraction is lethal. Although there are many possibilities, otolith marking is constrained by the number of available banding patterns.

Natural Markers

Genetic marks have been used for almost 30 years for the identification of Pacific salmon stocks. Once baselines are established for particular stocks, annual collections are not necessary because marker frequencies are relatively stable. Data for natural markers can be collected in both hatchery and wild stocks.

- Protein genetic markers (allozymes) – This technique was used in the 1980s and 90s to discriminate among Canadian / U.S. origin Chum stocks (Shaklee et al., 1990). Lethal sampling is often required for this method. No west coast laboratories are currently conducting allozyme analyses as this marker system has fallen out of widespread use in salmon assessment applications.
- DNA based markers – Are a widely accepted class of markers used to identify discrete salmon stocks. Sampling methods for both of the following techniques are non-lethal:
  i. Microsatellite markers (mSAT) – In the last 5 years, a mSAT baseline for Chum has been developed and is being used on a limited basis (Kirby, 2007); and
  ii. Single-nucleotide Polymorphisms (SNPs) – More recently, SNPs have been developed and evaluated for several species of Pacific salmon for stock separation (Smith et al., 2005; and Elfstrom et al., 2006). The State of Alaska is currently using a newly developed SNPs baseline to differentiate local and large aggregate stocks of Chum salmon.

mSAT versus SNPs

In comparing the DNA based techniques for Chum stock identification, the following factors are important:

- Potential for stock resolution: The Chum Chapter minimally requires stock separation of large aggregates (Fraser, Canadian Inside non-Fraser and Washington) in mixed stock samples. However, domestic and conservation needs in Canada and the U.S. require finer stock resolution. Generally both methods have been judged to be capable of delivering the minimal requirements. The potential for further stock resolution is currently under evaluation;
- Costs of processing samples: 2008 costs are approximately $22 to $43 per fish for ~15 mSAT markers (15 alleles/locus). Presently processing costs for SNPs are comparable but include 64 markers (2 alleles/locus). Laboratory automation should decrease costs of both methods;
- Standardization (repeatability between laboratories): mSAT analyses require some degree of subjective laboratory interpretation of DNA patterns. SNPs are objectively scored and results are therefore comparable among laboratories with minimal standardization;
- Processing time: Processing time for mSATs and SNPs is approximately the same. However, SNPs have a higher potential for automated processing and further reductions in analysis time;
- Levels of accuracy and precision: Based on a number of comparisons, accuracy and precision has been similar for mSAT and SNP (eg. Smith et al., 2007; Smith and Seeb, 2008); and
- Status of baselines: There is a standardized coast-wide mSAT baseline for chinook salmon (Seeb et al., 2007). Direction has been provided from the GSI Steering Committee and the Pacific Salmon Commission's Committee on Scientific Cooperation

(PSC, 2008) to further develop SNP markers and evaluate their performance for separating Chinook stocks relative to mSATs. For Chum salmon, mSAT baseline development is largely complete for southern BC but inadequate for the Washington origin stocks. Currently there are SNP baseline data for Alaskan stocks and some Southern BC and Washington stocks.

Direction for Chum Salmon

Based on the extensive discussion within the bilateral Chum Technical Committee and geneticists from Alaska, Canada and Washington State, the Committee has agreed:

1) to use existing mSAT techniques for current* analyses;
2) to support further development of SNP technologies and the collection and evaluation; of issue-specific baseline information for future** analyses; and
3) to support the development of a standardized SNP coast-wide baseline.

*Short Term (Phase-in Period)

i. Stock identification of mixed stock fishery samples should continue to rely on the existing mSAT technology;
ii. When feasible, parallel analysis should be conducted on the mixed stock fishery samples, using the emerging SNP technology;
iii. Identify representative Chum stocks from Canada and U.S. based on size of stock, geographical area, run timing, stock "uniqueness", and fishery contribution. mSAT and/or SNP baseline data should be incorporated into a coast-wide baseline;
iv. Develop a standardized field sampling plan to collect the remaining tissues to complete the SNP baseline. Recently archived tissue samples could be incorporated into this SNP baseline;
v. Support the funding of research to improve the performance of the SNP baseline in mixed stock fisheries; and
vi. Support the funding of research to evaluate the comparability of the two technologies with respect to international, domestic, and conservation needs.

**Long Term

i. Support the expansion of adequate SNP markers to further Chum stock resolution capabilities for international, domestic, and conservation needs; and
ii. Support the maintenance of a dynamic and standardized coast-wide genetic baseline for Chum salmon.

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